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THE
CENTRE OF OSSIFICATION
IN THE
LOWER FEMORAL EPIPHYSIS
IN RELATION TO
FORENSIC MEDICINE

INAUGURAL DISSERTATION
FOR THE
ATTAINMENT OF THE DOCTOR'S DEGREE
FROM THE
MEDICAL FACULTY OF THE UNIVERSITY OF BERNE
PRESENTED BY
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I.

In Medical Jurisprudence, the determination of the age in the Newborn is known to be of great importance, because, excluding abnormalities and foetal diseases, which must be thought of in cases of Infanticide, upon the age depends the capability of living, for only a child capable of life can live after birth, and only a living child can be killed.

In the Newborn the determination of age is by no means easy, because the development of the body passes through different phases which are more or less distinctly marked by particular physical conditions, to which may be added various individual differences which are dependent on other influences.

The capability of life in a child does not only begin at the end of a normal pregnancy, i. e. at the end of the 10th lunar month, but some months previously, the exact time cannot be easily defined, but it falls somewhere between the 7th and 8th month; so that in order to determine the viability in individual cases, a diagnosis is necessary for these last intra-uterine months. Evidently for such, a diagnosis must principally be sought in those conditions of the body which are constant, and those which are essential for the determination of the age.

For Forensic purposes an external examination is sufficient without an autopsy, in cases where the capability of life is in a high degree improbable, for in such cases, proof of the child having lived cannot be brought forward with certainty.

Regarding Forensic examinations, the Prussian Regulations ¹⁾ order for this purpose : —

(§ 23. Ergiebt sich aus der Beschaffenheit der Frucht, dass dieselbe vor Vollendung der dreissigsten Woche geboren ist, so kann von der Obduction Abstand genommen werden, wenn dieselbe nicht von dem Richter ausdrücklich gefordert wird.)

Further experience teaches us that the vital vigour of the child differs in proportion to the time elapsed since it has attained the power of independent life, so that in individual cases the vital power may be doubtful, may be probable, more or less certain, or certain as in fully developed children, without foetal diseases or deformities, in which case one speaks of the child as mature, and consequently capable of life. For this reason the so-called signs of maturity are of importance, and also those which characterise the 8th and 9th months of foetal life.

The determination of the age in every Autopsy in which the individual is unknown is certainly important, and must be considered in every external examination of the body, but in the Newborn it is indispensable, as may be seen for the reasons already given; on this account special attention is called to the point in paragraph 23, of the Prussian Regulations.

Such an examination when done in a competent manner is more satisfactory the younger the individual is, as the age can be more exactly determined; for in one case you can count not by months only, but by

¹⁾ Das Verfahren der Gerichtsärzte bei den gerichtlichen Untersuchungen menschlicher Leichen. Berlin 1876, p. 20.

weeks, while in the other with the fully developed and the aged, it is not even possible to count by years.

For our present purpose we principally take notice of those points which have reference to the maturity of the newborn child, and which are known as the so-called signs of maturity, of these there are quite a number, which have different diagnostic worth, partly because some are more certain than others, but also partly because many may only be seen in fresh bodies, and not in those more or less decayed. These facts are very important in Forensic Medicine as the subjects for examination are frequently decomposed.

For both reasons the relations of the Skeleton, viz : the length of the body, and the condition of ossification of the bones, have a particular importance; also the horny substances, such as nails and hair, which are longer preserved; while the condition of the soft parts, important as they may be in fresh subjects, are for the most part lost, and consequently not to be relied upon in the decomposed; for example, the presence of the testicles in the Scrotum, the covering of the nymphæ by the Labia majora, the colour of the skin, the insertion of the umbilicus etc.

Again, the diameters of the head where the relations of size are so important for the determination of the age, lose this significance in the case of advanced decomposition, for the sutures become softened, the capsule of the brain empties itself, and the cranial bones fall together, thus becoming so ill-shaped that no normal dimensions can be taken. Further, the body-weight becomes more or less untrustworthy by decomposition,

or in consequence of losses by animals, so that we may have only the condition of the skeleton upon which to rely for the determination of the age, namely, its length, and the condition of ossification in the bones, to these, for reasons to be mentioned later on, belong especially the centre of ossification in the lower femoral Epiphysis, and the above given Prussian Regulations specially demands the consideration of these points.

(§ 23. Endlich ist noch zu ermitteln, ob und in welcher Ausdehnung in der unteren Epiphyse des Oberschenkels ein Knochenkern vorhanden ist.)

Béclard ¹⁾ was the first to call attention to this centre of ossification; since then it has been found and described by others, among whom we may mention *Ollivier* ²⁾ and *Mildner* ³⁾.

Köllicker ⁴⁾ gives a very instructive account of this centre of ossification which he found in a transverse section of the whole femur in a fully developed child which had lived for two weeks: and *Casper* has already in the first editions of his Practical Handbook of Forensic Medicine mentioned this osseous nucleus among the signs of maturity of the child.

Since then in all the later works on Forensic Medicine mention is made of this centre of ossification, and consequently many circumstances relating to it have been learnt, which can be used for Forensic purposes, and at

¹⁾ Nouv. journ. de Méd., Chir. et Pharm. Tom. IV. Paris, 1819, p. 107.

²⁾ Annales d'hygiène, publ. T. 27. 1842, p. 342.

³⁾ Prager Vierteljahrsschrift. B. 28. 1850, p. 39.

⁴⁾ Handbuch der Gewebelehre der Menschen. 5. Aufl. 1867, p. 212. fig. 154.

the present day this condition of ossification cannot be left unnoticed.

Nevertheless the subject is by no means sufficiently known, and the object of this treatise is to give some additions to what is already published, by means of a number of cases examined by *Herr Prof. Emmert*, and which he has kindly lent me for this purpose.

Generally the centre of ossification is to be found in the lower femoral epiphysis, lying in the centre, of a roundish form, and usually, but not always present. With reference to the last point, statistical accounts do not quite agree, and nothing is mentioned concerning the ossification in this epiphysis when the central centre of ossification is wanting.

G. Hartmann ¹⁾ among 165 fully developed fœtuses, found it absent in 12; while *Casper* ²⁾ found no centre of ossification in 14 out of 413 cases of fully developed fœtuses.

By putting our cases together we are able to give some other results as is seen from the following:—

II.

In the following collection of autopsies of a certain number of newborn children, the results are principally

¹⁾ Beiträge zur Osteologie der Neugeborenen. Eine Abhandlung zur Erlangung der Doctorwürde in der Medizin und Chirurgie unter dem Präsidium von Dr. H. Zurehka. Tübingen 1869. (Hartmann, zweiter Hauptlehrer an der königl. Länder-Hebammenschule zu Stuttgart.)

²⁾ Praktisches Handbuch der gerichtlichen Medicin. Neu bearbeitet und vermehrt von Dr. C. Liman. Bd. II. Berlin 1876, S. 848.

considered in reference to the centre of ossification in the lower femoral epiphysis, and at the same time a few other appearances which concern the age of the newborn, in order thereby more fully to become acquainted with what refers to the conditions of ossification in general. For instance, we considered the length of the body, its weight, the sex, and also the horny formations, fingernails, etc.

As the dissections have not for their purpose particular consideration for the 3fold centre of ossification, the accounts of the same still leave a good deal to be wished for, yet they afford valuable material for further enlightenment on this subject.

1.

Sex female.

Weight of body 2950 grm.

Length of body 50.5 centim.

Diameters of head: — a) Occipito-mental 15 cm.
b) Occipito-frontal 12,5 cm. c) Bi-parietal 9 cm.

Horizontal circumference of head 35 cm.

Nails extend beyond the finger ends.

Nymphæ covered.

Centre of ossification roundish and central in both lower femoral epiphyses of 4.5 m.m. in diameter.

2.

Sex female.

Weight of body 2950 grm.

Length of body 46.0 cm.

Diameters of head: — a) Occipito-mental 13 cm.
b) Occipito-frontal 12 cm. c) Bi-parietal 9 cm.

Horizontal circumference of head 34.5 cm.

Nails extend beyond the finger ends.

Nymphæ covered.

Centre of ossification, central and roundish in both lower femoral epiphyses of 5 m.m. in diameter.

3.

Sex male.

Weight of body 3000 grm.

Length of body 51.5 cm.

Diameters of head: — a) Occipito-mental 14.5 cm.

b) Occipito-frontal 13 cm. c) Bi-parietal 9.5 cm.

Horizontal circumference of head 35 cm.

Testicles descended.

Nails extend beyond ends of fingers.

Centre of ossification, round and central in both lower femoral epiphyses of 4.5 m.m. in diameter.

4.

Sex male.

Weight of body 3450 grm.

Length of body 52 Centim.

Diameters of head: a) Occipito-mental diameter 14.5 cm. b) Occipito-frontal 12 cm. c) Bi-parietal diameter 9.5 cm.

Testicles descended on both sides.

Nails extend beyond the ends of the fingers.

Centre of ossification, central and round in both lower femoral epiphyses of 6.5 m.m. diameter.

5.

Sex male.

Weight of body 3500 gramm.

Length of body 54 cm.

Diameters of head: a) Occipito-mental diameter 15 cm. b) Occipito-frontal 12 cm. c) Bi-parietal 9 cm.

Testicles descended on both sides.

Nails extend beyond the ends of the fingers.

Centre of ossification in lower femoral epiphysis central, of greatest transverse diameter of 4 m.m. Also scattered around it, several red *ossifying points*, which when touched with the point of the knife crepitate, and feel through.

6.

Sex female

Weight of body 3015 grm.

Length of body 52 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 12.5 cm. c) Bi-parietal 10 cm.

Horizontal circumference of head 34.4 cm.

Nymphæ covered.

Nails extend beyond the end of the fingers.

Centre of ossification, central and round, of 5 m.m. diameter in both lower femoral epiphyses.

7.

Sex male.

Weight of body 2230 grm.

Length of body 47 cm.

Diameters of head: a) Occipito-mental 13.5 cm. b) Occipito-frontal 11 cm. c) Bi-parietal 8 cm.

Horizontal circumference of head 33 cm.

Testicles both in scrotum.

Nails extend beyond the ends of the fingers.

Centre of ossification, central and round, in both lower femoral epiphyses, of 3.5 m.m. in diameter.

8.

Sex female.

Weight of body 2510 grm.

Length of body 47 cm.

Diameters of head: a) Occipito-mental 13.5 cm.

b) Occipito-frontal 11 cm. c) Bi parietal 10 cm.

Horizontal circumference of head 34 cm.

Nymphæ covered.

Nails extend beyond the ends of the fingers.

Centre of ossification, central and round, in both lower femoral epiphyses, of 4.5 m.m. diameter.

9.

Sex female.

Weight of body 3080 grm.

Length of body 51 cm.

Diameters of head: a) Occipito-mental 15 cm. b) occipito-frontal 12 cm. c) Bi-parietal 9.8 cm.

Horizontal circumference of Head 34.5 cm.

Nymphæ covered.

Nails extend beyond the ends of the fingers.

Centre of ossification, central and round, in both lower femoral epiphyses of 4.5 m.m. diameter.

10.

Sex male.

Weight of body 1440 grm.

Length of body 40 cm.

Diameters of head: a) Occipito-mental 10 cm. b) Occipito-frontal 8.5 cm. c) Bi-parietal 7.8 cm.

Horizontal circumference of head 25.5 cm.

Testicles only the left in scrotum.

Nails do not extend beyond the tips of the fingers.

Centre of ossification, central and round, in both lower femoral epiphyses of 2 m.m. diameter.

11.

Sex female.

Weight of body 1560 grm.

Length of body 41 cm.

Diameters of head: a) Occipito-mental 9.5 cm. b) Occipito-frontal 8.5 cm. c) Bi-parietal 6.5 cm.

Nymphæ not covered.

Nails do not extend beyond ends of fingers.

Centre of ossification in both lower femoral epiphyses but somewhat to the outer side, round and of 2.5 m.m. diameter.

Cases 10 and 11 were twins.

12.

Sex female.

Weight of body 2375 grm.

Length of body 48 cm.

Diameters of head: a) Occipito-mental 13.5 cm. b) Occipito-frontal 11 cm. c) Bi-parietal 9 cm.

Nymphæ not fully covered.

Nails scarcely extend beyond the finger ends.

Centre of ossification round and central in both lower femoral epiphyses of 4 m.m. in diameter.

13.

Sex male.

Weight of body 1900 grm.

Length of body 48 cm.

Diameters of head: a) Occipito-mental 12 cm. b) Occipito-frontal 10 cm. c) Bi-parietal 10 cm.

Horizontal circumference of head 29 cm.

Centre of ossification none central, but some scattered red ossifying points, which can be recognised as such by feeling and by crepitation under the point of the knife.

14.

Sex male.

Weight of body 2800 grm.

Length of body 50 cm.

Diameters of head: a) Occipito-mental 14.5 cm b) Occipito-frontal 11 cm. c) Bi-parietal 9.4 cm.

Horizontal circumference of head 34 cm.

Testicles descended on both sides.

Nails extend beyond the ends of the fingers.

Centre of ossification, central and round, in both lower femoral epiphyses of 4.5 m.m. in diameter.

15.

Sex female.

Weight of body 2280 grm.

Length of body 49 cm.

Diameters of head: a) Occipito-mental 13 cm. b) Occipito-frontal 10.5 cm. c) Bi-parietal 9 cm.

Horizontal circumference of head 30.5 cm.

Nymphæ covered.

Nails scarcely extend beyond the finger-tips.

Centre of ossification, central and round, in both lower femoral epiphyses of 4.5 m.m. in diameter.

16.

Sex male.

Weight of body 3250 grm.

Length of body 52 cm.

Diameters of head: a) Occipito-mental 14.5 cm.
b) Occipito-frontal 12.3 cm. c) Bi-parietal 10 cm.

Testicles on both sides in scrotum.

Nails extend beyond ends of fingers.

Centre of ossification, round and central, in both lower femoral epiphyses, of 4.5 m.m. in diameter.

17.

Sex female.

Weight of body 2057 grm.

Length of body 46 cm.

Diameters of head: a) Occipito-mental 12 cm. b) Occipito-frontal 10 cm. c) Bi-parietal 8 cm.

Nymphæ covered.

Nails do not extend beyond the ends of the fingers.

Centre of ossification, central and round, in both lower femoral epiphyses, of 3 m.m. in diameter.

18.

Sex female.

Weight of body 3000 grm.

Length of body 52 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 12 cm. c) Bi-parietal 9.5 cm.

Nymphæ covered.

Nails extend beyond the finger tips.

Centre of ossification, central and round, in both lower femoral epiphyses, of 5 m.m. diameter.

19.

Sex female.

Weight of body 4100 gm.

Length of body 52.5 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 12 cm. c) Bi-parietal 9.5 cm.

Nymphæ covered.

Nails extend beyond finger-tips.

Centre of ossification wanting in the centre of the lower femoral epiphyses, but several scattered red ossifying points are present which can be recognised as such by being rough and crepitating under the point of the knife.

20.

Sex male.

Weight of body can not be entirely given, because some of the soft parts are lost through animals, but what remains weighs 2125 gm.

Length of body 48 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 12.5 cm. c) Bi-parietal 9 cm.

Testicles on both sides descended.

Nails scarcely extend beyond the finger-tips.

Centre of ossification, round and central in both lower femoral epiphyses, of 3.5 m.m. diameter.

21.

Sex male.

Weight of body 2510 gm.

Length of body 54 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 12 cm. c) Bi-parietal 9 cm.

Testicles on both sides descended.

Nails extend beyond the finger-tips.

Centre of ossification, central and round in both lower femoral epiphyses of 4.5 m.m. diameter.

22.

Sex male.

Weight of body 3500 grm.

Length of body 49.5 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 10.5 cm. c) Bi-parietal 9 cm.

Testicles in scrotum in both sides.

Nails extend beyond the finger tips.

Centre of ossification in both lower femoral epiphyses, round and central and of 4.5 m.m. diameter.

23.

Sex male.

Weight of body 1500 grm.

Length of body 48 cm.

Diameter of head: a) Occipito-mental 13.5 cm. b) Occipito-frontal 9.5 cm. c) Bi-parietal 8 cm.

Testicles only the right descended.

Nails scarcely extend beyond the finger tips.

Centre of ossification, central and round, in both lower femoral epiphyses of 3.5 m.m. diameter.

24.

Sex male.

Weight of body 2625 grm.

Length of body 48 cm.

Diameters of head: a) Occipito-mental 11.5 cm. b) Occipito-frontal 10 cm. c) Bi-parietal 9 cm.

Testicles on both sides descended.

No *centre of ossification* in the lower femoral epiphyses, but there are several scattered red *ossifying points*, which can be recognised as such by the point of the knife.

25.

Sex female.

Weight of body 3250 grm.

Length of body 52.5 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 12 cm. c) Bi-parietal 9 cm.

Nymphæ covered.

Nails extend beyond the ends of the fingers.

Centre of ossification in the lower femoral epiphyses, central, of somewhat oval form, with the longest transverse diameter of 6 m.m. diameter.

26.

Sex female.

Weight of body 2750 grm.

Length of body 48 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 12 cm. c) Bi-parietal 9 cm.

Nymphæ covered.

Nails extend beyond the finger tips.

Centre of ossification, central and round, in both lower femoral epiphyses of 4.5 m.m. diameter.

27.

Sex male.

Weight of body 3025 grm.

Length of body 50 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 12 cm. c) Bi-parietal 9.5 cm.

Testicles both sides descended.

Nails extend beyond the finger tips.

No *centre of ossification* in the lower femoral epiphyses, but several scattered red *ossifying points*, which can be recognised as such by the feel and the crepitation under the point of the knife.

28.

Sex female.

Weight of body 3000 grm.

Length of body 52 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 12.5 cm. c) Bi-parietal 9.5 cm.

Nymphæ covered.

Nails extend beyond the finger tips.

Centre of ossification, central and round, in both lower femoral epiphyses, of 6.5 m.m. diameter.

29.

Sex female.

Weight of body 3025 grm.

Length of body 52 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 12 cm. c) Bi-parietal 9 cm.

Nymphæ covered.

Nails extend beyond the finger tips.

No central *Centre of ossification* in the lower femoral epiphyses, but 3—4 scattered red *ossifying points*.

30.

Sex female.

Weight of body cannot be determined on account of decomposition being too far advanced.

Length of body 54 cm.

Diameters of the head cannot be taken exactly as the bones have become detached from their membranes, moreover the cranial bones are pressed together.

Nails are detached from the fingers.

Centre of ossification, central and roundish, in both lower femoral epiphyses. No longer to be distinctly recognised by its colour, as the whole cut surface presents a uniform dirty reddish appearance, but by examination with the point of the knife the most exact diameter that can be taken is 5 m.m.

31.

Sex female.

Weight of body no longer to be exactly determined as decomposition is too far advanced.

Length of body 45 cm.

Diameters of head cannot be exactly determined neither can the relation of the *Nymphæ* to the labia majora.

Nails do not extend over the finger tips.

No central *centre of ossification*, but several scattered *ossifying points* which are to be recognised partly by their colour, and partly by the point of the knife.

32.

Sex male.

Weight of body 3550 grm.

Length of body 53 cm.

Diameters of head: on account of displacement of the bones of the head, cannot be exactly determined.

Testicles only the right descended.

Nails extend beyond the finger tips.

Centre of ossification, central and roundish, in both lower femoral epiphyses, of 6 m.m. diameter.

33.

Sex male.

Weight of body 3250 grm.

Length of body 54 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 12 cm. c) Bi-parietal 9.5 cm.

Testicles on both sides descended.

Nails extend beyond finger tips.

Centre of ossification, central and roundish, in both lower femoral epiphyses of 5 m.m. diameter.

34.

Sex female.

Weight of body 1375 grm.

Length of body 38 cm.

Diameters of head: a) Occipito-mental 10.5 cm. b) Occipito-frontal 9 cm. c) Bi-parietal 7.5 cm.

Nymphæ not covered by the labia majora.

Nails scarcely extend to the finger tips.

Centre of ossification in both lower femoral epiphyses, central, and of 1 m.m. in diameter.

35.

Sex male.

Weight of body 2000 gm.

Length of body 45 cm.

Diameters of head: a) Occipito-mental 13.5 cm.

b) Occipito-frontal 11 cm. c) Bi-parietal 8 cm.

Testicles only the left descended.

Nails do not extend beyond the ends of the fingers.

No central centre of ossification in the lower femoral epiphyses, but several scattered red ossifying points.

36.

Sex male.

Weight of body 3025 gm.

Length of body 51 cm.

Diameters of head: a) Occipito-mental 14.5 cm.

b) Occipito-frontal 12.5 cm. c) Bi-parietal 10.5 cm.

Horizontal circumference of head 35 cm.

Testicles on both sides in scrotum.

Nails extend beyond the finger tips.

No central centre of ossification, in the lower femoral epiphyses, but several scattered small ossifying points.

37.

Sex female.

Weight of body cannot be determined because the child was found in pieces. First, the body with the left lower extremity, later the head with the neck, and the right lower extremity.

Diameters of the head: also not to be determined, as the head had been found pressed down into, and had stuck in a drainage pipe.

Horizontal circumference of the head was nearly 34 cm.

Length of the body with the left lower extremity 39 cm. The skull with neck attached measured 13 cm. which together made a body length of 52 cm.

Nymphæ covered.

Nails extend beyond the finger ends.

Centre of ossification, central and roundish in the left lower femoral epiphysis of 4.5 m.m. in diameter, later on a similar *osseous nucleus* was found in the right lower femoral epiphysis.

38.

Sex male.

Weight of body 3025 grm.

Length of body 49 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 12 cm. c) Bi-parietal 9.5 cm.

Testicles both descended.

Nails extend beyond the finger tips.

Centre of ossification, central and roundish, in both lower femoral epiphyses, of 6 m.m. diameter.

39.

Sex female.

Weight of body 3900 grm.

Length of body 51 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 11.5 cm. c) Bi-parietal 9.3 cm.

Horizontal circumference of head 35 cm.

Nymphæ covered.

Nails extend beyond the finger tips.

Centre of ossification in both lower femoral epiphyses, central but not round, oval, with a transverse diameter of 5 m.m. and a vertical diameter of 4 m.m.

40.

Sex female. 1st twin-child.

Length of body 57 cm.

Centre of ossification in both lower femoral epiphyses, central and roundish, of 7.5 m.m. in diameter.

41.

Sex female. 2nd twin-child.

Length of body 54 cm.

Centre of ossification in both lower femoral epiphyses, central and roundish, of 6 m.m. in diameter.

Both children had lived from the 12th January 1870, till 24 April.

42.

Sex female.

Weight of body 2300 grm.

Length of body 50 cm.

Diameters of head: a) Occipita-mental 15 cm. b) Occipito-frontal 11.5 cm. c) Bi-parietal 9 cm.

Nymphæ covered.

Nails extend beyond the finger tips.

Centre of ossification, central and roundish in both lower femoral epiphyses, of 4.5 m.m. in diameter.

43.

Sex male.

Weight of body 1500 grm.

Length of body 36 cm.

Testicles not in scrotum.

Nails do not extend beyond the finger tips.

Neither *centre of ossification*, nor scattered *ossifying points* in the lower femoral epiphyses.

44.

Sex female.

Weight of body 850 grm.

Length of body 34 cm.

Nymphæ uncovered.

Nails not extend beyond the finger ends.

Neither *centre of ossification* nor *ossifying points* in the lower femoral epiphyses.

45.

Sex female.

Weight of body 2045 grm.

Length of body 51 cm.

Nymphæ covered.

Nails extend beyond the finger ends.

Centre of ossification, central and round, in both lower femoral epiphyses of 3.5 m.m. in diameter.

46.

Sex female.

Weight of body 3000 grm.

Length of body 51.5 cm.

Diameters of head: a) Occipito-mental 15 cm. b) Occipito-frontal 10.5 cm. c) Bi-parietal 9.5 cm.

Nymphæ covered.

Nails extend beyond the finger ends.

No central *centre of ossification* in the lower femoral epiphyses, but several scattered red *ossifying points*.

47.

*Sex male.**Weight of body* 3000 grm.*Length of body* 51 cm.*Diameters of head:* a) Occipito-mental 14.5 cm.

b) Occipito-frontal 12 cm. c) Bi-parietal 10 cm.

Testicles only right in scrotum.*Nails* extend beyond the finger tips.*Centre of ossification*, central and round, in both lower femoral epiphyses of 4 m.m. in diameter.

48.

*Sex male.**Weight of body* 3025 grm.*Length of body* 51.6 cm.*Diameters of head:* a) Occipito-mental 14.5 cm.

b) Occipito-frontal 13 cm. c) Bi-parietal 9 cm.

Horizontal circumference of head 35 cm.*Nails* extend beyond the finger ends.*Testicles* on both sides descended.*Centre of ossification*, central and roundish in both lower femoral epiphyses, of 4 m.m. in diameter.

49.

*Sex female.**Weight of body* 2500 grm.*Length of body* 51 cm.*Diameters of head:* a) Occipito-mental 13.5 cm.

b) Occipito-frontal 12 cm. c) Bi-parietal 9.5 cm.

Nymphæ covered.*Nails* extend beyond the finger tips.*Centre of ossification*, central and roundish, in both lower femoral epiphyses of 4 m.m. in diameter.

50.

Sex male.*Weight of body* 2525 grm.*Length of body* 51.5 cm.*Diameters of head*: a) Occipito-mental 14 cm. b) Occipito-frontal 10.5 cm. c) Bi-parietal 9 cm.*Testicles* both in scrotum.*Nails* extend beyond the finger tips.*Centre of ossification*, central and roundish in both lower femoral epiphyses, of 4.5 m.m. in diameter.

III.

In the 50 cases before us, extracted from the above mentioned autopsies, may be found several facts relating to conditions of ossification in the newborn; these have more or less Forensic importance and up to this time have not been sufficiently considered. By means of these extracts we have principally observed those physical conditions which generally concern the development of bone for instance, the length of the body, and the state of ossification.

To these are added some other points of development which have to be considered forensically, as the diameters of the head, the length of the nails, the external sexual organs, and their relation to the skeleton and advancement of ossification.

With reference to the presence in the lower femoral epiphysis of a central osseous nucleus which generally takes the form of a roundish crown, and is called the centre of ossification. Agreeing with the authors who have written on this subject, and judging from the de-

velopment in newborn children, who may, in the majority of cases, be considered capable of living, such a centre of ossification, varying in size according to the age of the child, may be found, so that its existence may always be taken as a sign of a child's viability, and its size a criterion for the age. Nevertheless the accounts concerning the frequency of the presence or absence of such a central osseous point, do not quite agree, as has already been mentioned in the quotations from *Hartmann* and *Casper-Liman*, and nothing further is remarked about the condition of ossification if the central osseous nucleus is wanting; in such cases, it seems generally accepted that the ossification had not made its appearance at all, and was completely absent, at least it can hardly be taken in any other sense when *Casper* ¹⁾ says that in a case of this sort, „keine Spur eines Knochenkerns gefunden wurde, namentlich dann, wenn auch sonst Zeichen einer ungewöhnlich zurückgebliebenen Entwicklung und Ossificationsdefecte in den Schädelknochen wahrnehmbar waren.“

The results of the autopsies in our cases contradict such a statement, and though the number be not large, yet they are sufficiently numerous to give some information. In the next place there was no case in which the centre of ossification was wanting, with the exception of those in which ossification had not at all begun, such as an abnormal backwardness in the development of the body, or a defect in the osseous formation of the skull-bones.

In the absence of a central centre of ossification, every trace of ossification in the lower femoral epiphysis

¹⁾ L. c. p. 848.

was by no means absent. when the body of the child, up to the beginning of its viability, was otherwise properly developed, it appeared only in another form, viz : not in a single round central osseous point, but in the form of single small round scattered specklike points of ossification.

These specks can be easily passed over, and taken for vascularisation of the cartilages, instead of osseous points when they are not examined in such a manner as has been done by *Herr Prof. Emmert*, viz : with the point of the knife, by this means the deposit of lime-salts can be distinctly recognised by the roughness and hardness of the red points, and by crepitation on scratching, without the use of the microscope. Of the given 50 cases, there are two (N^{os} 43, 44) in which on account of insufficient development, there were no beginnings of ossification to be found in the epiphysis in question. Putting these aside, in the remaining 48 cases, concerning viable children of various ages, there was in 39 a central osseous nucleus (thus 78 $\frac{0}{100}$), and in 9 scattered points of ossification. Only in one case (N^o 5) it happened that a central nucleus and scattered points of ossification were found together.

Regarding the mode of preparing the lower femoral epiphysis, in order to recognise the centre of ossification, the directions are very various, notwithstanding the simplicity of the operation. According to *Casper* ¹⁾ a horizontal section is made above the knee-joint, the extremity being strongly flexed, and the patella removed; then from the end of the presenting cartilage *thin hori-*

¹⁾ L. c. p. 833.

zontal cartilaginous strata are taken away till the largest diameter of the centre of ossification is reached. According to the Prussian Regulations ¹⁾ a transverse section ought to be made under the patella, the latter being removed, and the extremity strongly flexed: while according to the lectures of *Herr Prof. Emmert*, the removal of the patella is superfluous, and makes this simple operation more complicated. He makes a transverse cut above and into the knee-joint, and by pressure upon the patella with the thumb of the left hand, bends the femur to a right angle, he then cuts off from the free epiphysis, layers till he reaches the greatest diameter of the centre of ossification. This he orders to be done in both lower femoral epiphysis.

In fresh cartilaginous surfaces, in consequence of considerable vascularisation of this part, the centre of ossification appears ²⁾ when the greatest diameter is left bare, like a blood-red circumscribed slice, which feels hard and rough to the finger, and crepitates under the point of the knife. If instead of the central nucleus, there are several scattered osseous points, these appear on the cartilaginous surface as small specklike red points which are generally connected with a large vessel, and as osseous nuclei can be recognised by the usual tests, i. e. hardness, roughness, and crepitation by scraping with the knife:

In the collected cases given, the conditions of ossification were, taking all together, equal on both sides regarding the presence and size of the central centre of

¹⁾ L. c. p. 20.

²⁾ S. Köllicker, l. c. p. 212.

ossification as well as the osseous points; and it is very likely that the mutual assertions respecting its size according to *Casper-Liman* ¹⁾ rest on a very easily explained error. In as much as one cartilaginous stratum was taken off rather more thickly than the other, it would immediately shew a small difference in the diameter.

On the other hand, we could not agree with the mentioned authors, if they are on this account of opinion that it is sufficient to seek only *one* centre of ossification in a dissection. We should rather follow the directions of *Herr Prof. Emmert*, which is to examine, in all cases, both lower femoral epiphysis, as in some cases it has happened that the conditions of ossification on both sides seemed not quite alike. For instance, *Skrzeczka* ²⁾ tells us of a case in which he made the autopsy of a child of the male sex, 52.4 cm. long, and 3000 grm. in weight, in which the transverse diameter of the head was 8.5 cm., the straight diameter 10.4 cm. and the diagonal measured 12.4 cm. The centre of ossification in the right lower femoral epiphysis was absent, and that one in the left measured 1 mm. Nothing is mentioned of other possible ossifying points, still it may be imagined, that on account of the smallness of the nucleus of 1 mm. in an otherwise mature child, there was no central centre of ossification at all, but on both sides, only small scattered osseous nuclei were present, as hitherto this condition of ossification has not been considered by writers.

¹⁾ L. c. p. 848.

²⁾ Kindsmord in Handbuch der gerichtlichen Medicin. Herausgegeben von Maschka. Bd. I., 1881, S. 849.

Further to be drawn from the cases quoted by us, is that in those in which the central centre of ossification was present, it was of a roundish shape, and had a central position with few exceptions. In one case (N° 25) the shape was more oblong than round with the greatest diameter in the transverse direction; and also only in one case (N° 11) the centre of ossification was not quite central, but lying rather towards the outside.

Number of case	Sex	Length of body	Diameter of centre of ossification	Remarks.
N ^o 44	female	34 cm.	. . .	Neither central centre of ossification, nor ossifying points.
" 43	male	36 "	. . .	ditto.
" 34	female	38 "	1 m.m.	
" 10	male	40 "	2 "	Twin-child.
" 11	female	41 "	2.5 "	Twin. the centre of ossification lay towards the outside.
" 17	"	46 "	3 "	
" 2	"	46 "	5 "	
" 7	male	47 "	3.5 "	
" 8	female	47 "	4.5 "	
" 12	"	48 "	4 "	
" 20	male	48 "	3.5 "	
" 23	"	48 "	3.5 "	
" 26	female	48 "	4.5 "	
" 15	"	49 "	4.5 "	
" 38	male	49 "	6 "	
" 22	"	49.5 "	4.5 "	
" 1	female	50.5 "	4.5 "	
" 14	male	50 "	4.6 "	
" 42	female	50 "	4.5 "	
" 3	male	51.5 "	4.5 "	

Number of case	Sex	Length of body	Diameter of centre of ossification	Remarks.
N ^o 9	female	51 cm.	4.5m.m.	
" 39	"	51 "	5 "	Transverse, and 4 m.m. vertical direction.
" 45	female	51 "	3.5 "	
" 47	male	51 "	4 "	
" 48	"	51.6 "	4 "	
" 49	female	51 "	4 "	
" 50	male	51.5 "	4.5 "	
" 28	female	52 "	6.5 "	
" 4	male	52 "	6.5 "	
" 18	female	52 "	5 "	
" 16	male	52 "	4.5 "	
" 37	female	52 "	4.5 "	Child found in pieces.
" 6	"	52 "	5 "	
" 25	"	52.5 "	6 "	In the greater transverse diameter.
" 32	male	53 "	6 "	
" 5	"	54 "	4 "	Also some scattered ossifying points.
" 33	"	54 "	5 "	
" 21	"	54 "	4.5 "	
" 30	female	54 "	5 "	Decomposed body.
" 41	"	54 "	6 "	Twin-child, lived 3 months and 12 days.
" 40	"	57 "	7.5 "	ditto.

From this collection we see next that with children having a body-length of 34 cm. and 36 cm. Every trace of ossification was absent, there being neither the beginning of a centre of ossification, nor scattered ossifying points present.

On the other hand, the forming of a centre of ossification of 1 mm. in diameter was noticed with a body length of 38 cm. thus sometime between the 7th and 8th month, at which time, in the majority of cases, the viability of children begins. The opinion of *Meckel* ¹⁾, *Ollivier*, and others, that the ossification begins only in the last month of pregnancy is therefore, not correct, and also the opinions of more modern authors (*Casper*, *Liman*, *Skrzeczka* and others), which bring the formation to the 9th month of pregnancy does not quite answer to the real occurrence, and it is rather the 8th month in which the ossification in the lower femoral epiphysis may begin.

Regarding the relations of the dimensions of the centre of ossification to the length of the body. it cannot be mistaken from the above tables, that in general with the growth of the skeleton, the dimensions of that centre also increase, but a quite proportional addition is not shewn, however, many varying individual differences occur, so that it would be hardly possible to draw conclusions from a given certain size of the centre of ossification, to a certain size of body length.

The dimensions of this osseous nucleus from its beginning till the end of a normal pregnancy, has a length

¹⁾ Handbuch der menschlichen Anatomie. B. II. 1816. S. 255. § 753.

of 1—6 mm. and from this, one can always conclude, that where the beginning of ossification has been shewn, the viability of the child has begun.

The greatest diameter, viz : over 7 mm. was found in a child that had lived for three months.

With reference to the frequency of its presence, or to its size, *sex* does not seem to have any special influence.

Points of ossification in different places in the lower femoral epiphysis, instead of only one central ossifying nucleus, were found in the following *lengths* of body :

Number of case	Sex	Length of body	Remarks.
N ^o 31	female	45 cm.	
" 35	male	45 "	
" 13	"	48 "	
" 24	"	48 "	
" 27	"	50 "	
" 36	"	51 "	
" 46	female	51 "	
" 29	"	52 "	3—4 ossifying points.
" 19	"	52.5 "	

These points of ossification were therefore observed in newborn children, some quite, and some almost, mature, indeed, in nearly one fifth of the cases quoted by us, without Forensic dissection shewing any further abnormal conditions of development. There was also about an equal number of each sex, so this point cannot be supposed to have any influence.

It is conspicuous that in the very excellent „Handbuch der gerichtlichen Medicin“ by *Casper-Liman* ¹⁾ the following remark is made: „Während noch die Epiphyse keines einzigen langen Knochens im letzten (zehnten Monats-) Monat des Fruchtlebens einen Anfang von Ossification zeigt, bildet sich in der zweiten Hälfte des letzten Monats in der genannten Epiphyse der erste Knochenkern aus.“ For apart from the incorrectness of the last assertion, the first is also inaccurate, as in the case of mature, or almost mature newborn children, the points of ossification are not limited to the lower femoral epiphysis, but are also found in the extremities of other bones, as for instance in the Tibia and Humerus, of which *Barkow* ²⁾ has made some observations. He found several times in still-born children an epiphysal nucleus in the capitulum ossis humeri, also in the upper Tibial epiphysis. In the majority of cases of newborn, where he found a Tibial nucleus, according to the degrees of development, the children might be considered fully mature, and in those cases where the nails extended beyond the finger-tips the osseous nucleus had a diameter of $1-1\frac{1}{2}$ line.

Probably in the ossification of the Tibial and Humeral epiphyses, the same conditions will be found as in the femoral, namely this, that if one, more or less central, single centre of ossification be absent, small scattered osseous points may be found.

¹⁾ Bd. II. 1876. S. 833.

²⁾ Beiträge zur pathologischen Entwicklungsgeschichte. Breslau 1871. S. 58.

The cases mentioned by *Barkor*, which moreover all concern children with hemieranial formations are as follows: —

Number	Sex	Length of body	Centre of ossification in femur	Centre of ossification in tibia	Centre of ossification in humerus
		cm.	cm.	cm.	
1	male	38	$\frac{3}{10}$ trans. diam.	$\frac{3}{10}$ trans. diam.	
2	female	34	$\frac{6}{10}$ " "	$\frac{3}{10}$ " "	
3	"	42	$\frac{7}{10}$ " "	$\frac{6}{10}$ " "	$\frac{2}{10}$ cm. trans. diameter.
4	"	39	$\frac{6}{10}$ " "	$\frac{4}{10}$ " "	no centre of ossification.
5	"	37	$\frac{6}{10}$ " "	$\frac{6}{10}$ " "	

These observations shew that even in other long bones, points of ossification occur, which may be employed for the determination of the age, but for Forensic purposes, the femoral centre of ossification is to be preferred, being easily accessible, easily described, and also more reliable than the humeral osseous nucleus; therefore it is right that among the signs of a child's maturity, the femoral epiphysis should first be examined.

Now with regard to the *diagnostic importance* of these ossifying conditions, several circumstances are to be taken into consideration: That the value is somewhat diminished in that the centre of ossification is sometimes absent, which happens in about one fifth of the cases quoted by us, and that instead of it, there are several scattered points of ossification, so that from the latter the beginning of ossification may be shewn, but not the different degrees of maturity of the child; still these

conditions are dependent on many individual fluctuations, and the size of the nucleus by no means stands in a fixed proportion to the length of the body, or the age of the child, so that we must not put too much weight on these signs of development, any more than on the others, but the sum of the various degrees of maturity must be considered.

However the femoral centre of ossification is easily describable and has too much diagnostic importance, ever to be overlooked in a Forensic autopsy. It first appears about the time the child becomes viable, and can be used for the determination of this point; if it has a diameter of 4,5—5—6 mm. this speaks for the maturity of the child, greater dimensions may be used for proving that the child has already lived.

Further, the fact, that so to speak, in all cases, the form, size and position of the centre of ossification are the same on both sides, is so far of diagnostic value that thereby may be considered whether disunited parts belong to the same child, as in case N° 37 quoted by us, which gives an example of this.

Nevertheless the greatest diagnostic importance attached to this condition of ossification lies in the fact, that it can be used even in cases where great decomposition is present, and when the softer parts are lost, (*Ollivier* ¹⁾ and *Casper* ²⁾) give instructive examples of such, also N° 30, of the examinations made by *Herr Prof. Emmert*.

¹⁾ L. c. p. 346.

²⁾ L. c. p. 849.

If only one femur of a child, indeed if only the lower epiphysis of such, be found, the presence and dimensions of a central centre of ossification are sufficient to determine the age, the viability depending on it, and also whether the child has lived or not, if the dimensions of the nucleus are such as are found in mature children i. e. over 6—7 mm. in diameter.

Therefore the femoral centre of ossification has usually a Forensic importance above all others for indicating the age of the newborn.



